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Practical Exploration, Technological Integration, and Development Path of Bilingual Interpretation: A Case Study Analysis Based on Multi-Scenario Literature

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Abstract

The 21st century has witnessed unprecedented global changes. With the deepening of globalization, cultural exchanges between countries have become increasingly frequent, and bilingual interpretation has emerged as a crucial medium for cross-cultural communication. It plays an irreplaceable role in facilitating tourists' access to information, disseminating China's excellent traditional culture, and enhancing the soft power of cultural competition. Through background analysis, literature review, case studies, and field investigations, this study explores the practical application modes of bilingual interpretation in key Sino-foreign cultural exchange scenarios, including schools, scenic areas, museums, and cultural heritage sites. It also identifies existing problems, such as uneven translation quality, inaccurate and insufficient cultural information dissemination, and inadequate application of technology, and proposes targeted solutions—including the construction of a standardized professional terminology database, optimization of bilingual interpreter training systems, and improvement of interpretation technology application.

***Keywords*— Bilingual Interpretation; Cross-Cultural Communication; Cultural Tourism; Translation Quality; Smart Tourism**

I. INTRODUCTION

1.1 Research Background

The current international situation is complex and volatile, with intensified technological competition and resource rivalry. Among various resources, tourism resources are critical to the economic income of countries and regions. Against the backdrop of fierce competition in cultural and tourism destinations, providing professional, user-friendly, and multilingual interpretation services (especially for minority languages) has become a core competitive advantage—it helps demonstrate international service standards, attract high-end tourists, and build brand images. Leading institutions such as the Palace Museum and Shanghai Museum have launched multilingual intelligent interpretation services, setting benchmarks for the industry.

With the deepening of international exchanges, cross-border tourism, business trips, and study-abroad programs have become more frequent than ever. Data from the World Tourism Organization (UNWTO) shows that in 2024, the number of international tourists worldwide has rebounded significantly, approaching pre-pandemic levels. However, language barriers have become the most prominent obstacle affecting tourists' in-depth travel experiences.

1.2 Research Significance

Bilingual interpretation eliminates language barriers, facilitates communication and business cooperation, and promotes cross-cultural exchange, understanding, and respect. It also improves tourism services, enhances

tourist satisfaction and revisit rates, and generates economic benefits. Studying bilingual interpretation is an inevitable requirement for cultural exchange in the era of globalization: it supports the high-quality development and innovation of the cultural and tourism industry, serves as a new application field for emerging technologies, and deepens the integration of interdisciplinary theories.

The development of bilingual interpretation not only affects the efficiency of information dissemination but also exerts a profound impact on cross-cultural understanding, the quality of tourism experiences, and the mutual learning and advancement of human civilizations.

1.3 Research Framework

This study is structured into four parts: theoretical analysis, practical cases, problem diagnosis, and countermeasure proposals. First, by analyzing existing theoretical models, it clarifies the definition and functions of bilingual interpretation systems in China's tourism industry. Second, it conducts in-depth analysis of practical cases (e.g., the Palace Museum, Nanjing City Wall and Zhonghuamen Castle, Shanghai City Sightseeing Double-Decker Buses, and the British Museum App) to identify loopholes. Finally, it proposes optimization suggestions targeting specific issues.

II. CORE CONCEPTS AND THEORETICAL FOUNDATIONS

2.1 Definition of Core Concepts

2.1.1 Bilingual Interpretation

Bilingual interpretation refers to a service that utilizes two languages (typically a native language and an international language, such as Chinese and English) to transmit information, provide explanations, and facilitate communication in interpretation practices. Its core classifications and characteristics are as follows:

- **Classification by service carrier**:
    a. *Human bilingual interpretation*: Centered on professional interpreters, it provides services through face-to-face explanations, voice broadcasts, etc. Its advantages include high flexibility and the ability to conduct in-depth cultural communication.
    b. *Intelligent bilingual interpretation*: Relying on technological systems, it integrates mobile Internet, speech recognition, and machine translation technologies to deliver services via apps, mini-programs, and intelligent devices. It is characterized by wide coverage, high efficiency, and low costs.
- **Classification by application scenario**:

It can be further divided into museum bilingual interpretation, scenic area bilingual interpretation, campus bilingual interpretation, and commercial venue bilingual interpretation. Different scenarios differ in content design, functional requirements, and service groups: for example, museum bilingual interpretation emphasizes the accuracy and depth of cultural information, while scenic area bilingual interpretation focuses on the convenience and personalization of route guidance.

2.1.2 Core Functions of Bilingual Interpretation

1. **Real-time language translation**: Accurately translates information between two languages, eliminates language barriers, and ensures that users with different native languages can simultaneously access interpretation content (e.g., cultural relic explanations, route guidance, safety reminders).
2. **In-depth cultural adaptation**: Goes beyond literal translation to adjust expressions based on the cultural background of the target audience (e.g., explaining allusions, conveying values), avoiding the dilution of cultural connotations and promoting equal information dissemination and emotional resonance.
3. **Context-aware information sharing**: Utilizes location-based services and image recognition technologies to automatically trigger interpretation or guidance in the appropriate language when users are in specific time-space contexts (e.g., near an exhibit or at an intersection), providing seamless, companion-like services.
4. **Multi-modal interaction support**: Integrates voice, text, images, and AR/VR tools to meet diverse user preferences and needs (e.g., voice explanations, text reading, enhanced visual effects), enabling flexible information access and immersive experiences.
5. **Customized personalized experience (advanced function)**: Uses user data (e.g., age, interests, language proficiency) to intelligently push tailored content and routes (e.g., story-based explanations for children, in-depth academic analysis for scholars), providing targeted interpretation services.

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6. **Cultural information sharing**: Addresses language and cultural barriers that hinder the dissemination of China's profound historical and cultural resources, increasing tourists' cultural gains and revisit intention by sharing landscape culture in multiple languages.
7. **Cultural symbol explanation**: Accurately and vividly explains the connotations of cultural symbols, customs, and values in scenic areas, ensuring that tourists (who may lack long-term exposure to or in-depth study of Chinese culture) gain meaningful experiences.
8. **Experience enhancement**: Establishes personalized and interactive services based on Internet technologies to strengthen the sense of experience and immersion.
9. **Educational role**: Transforms language learning into practical application for interpreters or system users, improving language proficiency through practice and achieving informal education goals. It also enhances humanistic literacy and cultural confidence among domestic students and interpreters by deepening their understanding of cultural connotations.

2.1.3 Smart Tourism and Intelligent Interpretation Systems

1. **Smart tourism**: A new development model for the tourism industry that leverages advanced information technologies (e.g., cloud computing, big data, the Internet of Things (IoT), mobile Internet) to digitally and intelligently upgrade the entire process of tourism resource development, service provision, and operation management. Its core is to use technology to empower all links of the tourism industry chain, driving the industry's transformation from traditional models to digital and intelligent ones.
2. **Intelligent interpretation systems**: A key component of smart tourism systems. Supported by smart tourism technologies, their core functions include:
    - Automatic interpretation (e.g., location-based voice introductions to scenic spots);
    - Personalized route planning (optimizing routes based on tourist preferences and real-time visitor flow);
    - Multi-dimensional information search (covering scenic spot backgrounds, opening hours, and supporting services);
    - Interactive sharing (enabling one-click sharing of travel experiences on social platforms).

These functions provide tourists with a comprehensive and intelligent interpretation service process.

1. **Bilingual intelligent interpretation systems**: An enhanced version of intelligent interpretation systems with additional core features, including:
    - Real-time bilingual information translation (e.g., switching interface languages and scenic spot introduction texts between two languages);
    - Context-aware real-time translation (supporting bidirectional voice and text translation);
    - Bilingual interactive responses (enabling users to interact with the system using commands in different languages).

These features directly address the pain points of tourists with different language backgrounds and expand the coverage and applicability of intelligent interpretation services.

2.2 Theoretical Foundations of Bilingual Interpretation

2.2.1 Cross-Cultural Communication Theory

Proposed by American scholar Edward T. Hall in the 1950s, Cross-Cultural Communication Theory focuses on how people from different cultural backgrounds achieve effective communication, as well as the causes of communication barriers and their solutions. Its core propositions are: cultural differences affect people's language habits, thinking patterns, and behaviors, leading to communication obstacles; effective cross-cultural communication requires respecting cultural differences and integrating "cultural adaptation" with "language adaptation."

For bilingual interpretation, this theory provides important guidance:

- On the one hand, bilingual interpreters or intelligent systems must understand the language habits and thinking patterns of tourists from different cultural backgrounds to avoid information misunderstandings caused by cultural differences. For example, when explaining "dragon culture" in Chinese museums to Western tourists, it is necessary

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to emphasize the dragon's symbolic meanings of "good fortune and authority" to prevent tourists from associating it with the Western concept of dragons as "evil and terrifying."

- On the other hand, bilingual interpretation must use language translation to clearly convey cultural connotations, achieving "language transmission" and "cultural explanation" simultaneously. For instance, the bilingual interpretation service at the Nanyue King Museum not only translates basic exhibit information but also adds details about the historical background of Lingnan Culture, helping international tourists understand the cultural value of the exhibits.

2.2.2 Theory of Equal Access to Public Services

Derived from Western welfare state theory, this theory holds that governments or public institutions should provide fair and equal public services to all citizens—including groups with different languages, ethnicities, or income levels. It ensures citizens' equal right to access public services and emphasizes the integration of "equal opportunities" and "equal outcomes": different groups should have the same access to services, and services should be adjusted to ensure that different groups can actually obtain and use service content.

Bilingual interpretation is an important part of public cultural services, and its development aligns with the requirements of equal access to public services:

- For international tourists or non-local language speakers, language barriers prevent them from equally accessing interpretation service information. Bilingual interpretation addresses this by adapting to different languages, providing equal service access opportunities, and realizing "equal opportunities" in public cultural services.
- Meanwhile, by optimizing the content design and service methods of bilingual interpretation, it ensures that tourists with different language backgrounds can accurately understand information, achieving "equal outcomes." For example, bilingual intelligent interpretation systems in smart scenic areas provide multilingual voice explanations and text-image comparison guides, meeting the information needs of tourists with different languages and reflecting the concept of equal access to public services.

2.2.3 Technology Acceptance Model (TAM)

Proposed by American scholar Fred D. Davis in 1989, TAM is used to predict users' acceptance of information technology. Its core constructs are "perceived usefulness" and "perceived ease of use":

- "Perceived usefulness" refers to the extent to which users believe that using a particular technology can improve the efficiency of their work or daily lives;
- "Perceived ease of use" refers to the extent to which users believe that using a particular technology is easy or difficult.

The TAM model posits that users' perceptions of "perceived usefulness" and "perceived ease of use" affect their willingness to use technology, which in turn determines the actual adoption of the technology.

For the application of intelligent bilingual interpretation systems, TAM provides key guidance: the promotion and adoption of these systems depend on tourists' perceptions of their "perceived usefulness" and "perceived ease of use." If tourists believe the system can help them quickly obtain bilingual information (high perceived usefulness) and is simple to operate (high perceived ease of use), their willingness to use it will increase. Conversely, if the system has overly complex functions, cumbersome operations, or fails to meet tourists' actual needs, tourists will be unwilling to use it, affecting its effectiveness.

For example, the intelligent scenic area interpretation system studied by Zhu Lili (2022) optimized electronic maps and simplified operation steps to improve tourists' "perceived ease of use," while adding functions such as real-time translation and personalized recommendations to enhance "perceived usefulness"—these improvements significantly increased the system's adoption rate.

III. CASE STUDIES OF BILINGUAL INTERPRETATION

3.1 Museum Scenario: Foreign Language Program at Nanyue King Museum

3.1.1 Cultural Communication Effects

The Nanyue King Museum's foreign language program has effectively promoted the international dissemination of Lingnan Culture. From 2021 to 2023, the number of annual international media reports on the museum increased from 12 to 35, with renowned international media such as *The New York Times* and *The Times* covering the museum's bilingual interpretation services and Lingnan Culture exhibitions.

Meanwhile, the museum has expanded its international cooperation: by the end of 2023, it had established

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partnerships with 20 museums from 15 countries, conducting bilingual interpretation resource sharing and joint exhibitions to enhance the global influence of Lingnan Culture. As noted by Ouyi Ling (2023), this program adopted a communication model of "cultural relics + stories + bilingualism," making Lingnan Culture more accessible and acceptable to international tourists.

3.1.2 Industry Demonstration Effect

The Nanyue King Museum's foreign language program has provided replicable experiences for other museums in China. Many museums across provinces and cities have visited and learned from the program, then launched bilingual interpretation services tailored to their own conditions:

- The Museum of the Terra-Cotta Army in Xi'an adopted the program's "bilingual interpreter training model" and collaborated with local universities to establish a bilingual interpretation team;
- The Wuhou Shrine Museum in Chengdu introduced the program's "integrated service model of intelligent bilingual interpretation equipment and human interpreters" and deployed an intelligent interpretation system to improve services for international tourists.

Additionally, the National Cultural Heritage Administration included this program in the "Model Project for Internationalized Services of Museums."

3.1.3 Insights from the Case

1. **Talent is the core**: A high-quality bilingual interpreter team (with proficiency in languages, cultural knowledge, and cross-cultural communication skills) is essential for improving service quality. Museums should build such teams through "internal training + external cooperation."
2. **Content adaptation is key**: Bilingual interpretation content must first ensure linguistic accuracy, then explain cultural differences based on tourists' cultural backgrounds—integrating "language dissemination" and "cultural explanation" to avoid misunderstandings caused by cultural gaps.
3. **Technology is a supplement**: Intelligent bilingual interpretation tools can compensate for the limitations of human interpreters (e.g., limited coverage of time and space). Museums should appropriately apply these technologies to build a "human + intelligent tools" service model, expanding service coverage and improving efficiency.
4. **Innovation in communication methods**: Combine bilingual interpretation with international cultural exchange activities, using diverse formats such as "exhibitions + lectures + interactive activities" to enhance the interest and effectiveness of cultural communication.

3.2 Scenic Area Scenario: Intelligent Bilingual Interpretation System in Scenic Area M

3.2.1 Case Background

With the rapid development of smart tourism, many scenic areas in China have deployed intelligent interpretation systems to improve services and enhance tourist experiences. This case focuses on Scenic Area M, a national 5A-level mountain scenic area with core tourism resources including natural landscapes and historical and cultural relics. It receives over 5 million tourists annually, with approximately 8% being international tourists (2022 data).

To meet the interpretation needs of international tourists and respond to the call for smart tourism development, Scenic Area M collaborated with a technology company in 2021 to develop and launch an "intelligent bilingual interpretation system." The system's design and application referenced the functional framework and optimization ideas from Zhu Lili's (2022) study *Design Research on Intelligent Scenic Area Interpretation Systems Under the Background of Smart Tourism*.

3.2.2 System Design and Function Implementation

3.2.2.1 System Architecture Design

The intelligent bilingual interpretation system of Scenic Area M adopts a three-layer "cloud-edge-end" architecture:

- **Cloud layer**: Uses cloud computing to build a data storage and processing center, which stores the scenic area's geographic information, bilingual interpretation data for scenic spots, and tourist behavior data. It supports real-time data analysis and updates, providing data support for system functions.
- **Edge layer**: Deploys edge computing nodes within the scenic area to process time-sensitive tasks (e.g., speech recognition, positioning, navigation), reducing data transmission latency and improving system response speed.
- **End layer**: Includes two types of terminals: mobile terminals (apps, mini-programs) for tourists, and fixed terminals (intelligent interpretation screens,

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QR code signs) within the scenic area. These terminals provide diverse interaction channels for tourists.

3.2.2.2 Core Function Implementation (Bilingual Adaptation)

1. **Bilingual interpretation function**: Provides Chinese-English interpretation services (with language selection options for tourists). The content covers the historical background, natural features, and cultural value of scenic spots, presented in "voice + text-image" format. The voice content is recorded by professional bilingual broadcasters, ensuring standard pronunciation and moderate speed; the text-image part adopts side-by-side Chinese-English layout, with key information (e.g., scenic spot names, historical periods) highlighted in bold.
2. **Bilingual electronic map navigation function**: The electronic map uses bilingual labels for scenic spot names, road names, and service facility names (e.g., restrooms, restaurants, parking lots). It supports two positioning methods ("GPS positioning" and "QR code positioning") and a "POI filtering" function, allowing tourists to filter scenic spots by category.
3. **Bilingual travel log sharing function**: Enables tourists to take photos/videos via the system, add Chinese-English text descriptions (with translation assistance), and create a "travel log." The log can be shared on social platforms such as WeChat, Facebook, and Twitter. The system also includes a "popular logs" section to provide references for other tourists.
4. **QR code application function**: Deploys bilingual QR code signs next to each scenic spot and service facility. Scanning the QR code allows tourists to access bilingual interpretation information, locate themselves on the electronic map, and complete ticket verification or interpretation service booking.
5. **Bilingual information query function**: Provides comprehensive Chinese-English information query services (e.g., opening hours, ticket prices) and an "intelligent Q&A" function—tourists can input questions in Chinese or English, and the system returns answers in both languages.

3.2.3 Application Effects and User Feedback

3.2.3.1 Application Effect Data

1. **User coverage**: By the end of 2023, the system had 850,000 registered users, with international users (using the English interface) accounting for 12%—a significant increase from less than 3% before the system's launch.
2. **Service efficiency**: Before the system's deployment, each human interpreter served an average of 30 tourists per day; this number has decreased to 15. The average waiting time for tourists has been reduced from 40 minutes to 15 minutes, and the number of questions asked to staff has decreased by 45%.
3. **Stay time**: The average tourist visit duration has increased from 3.5 hours to 5 hours.

3.2.3.2 User Feedback

A 2023 satisfaction survey collected 2,000 valid questionnaires, with the following results:

- **Overall satisfaction**: 88% of users were satisfied (90% of Chinese users, 82% of English users).
- **Top-recognized functions**: Bilingual electronic map navigation (92% recognition rate) and bilingual interpretation (89% recognition rate) were the most popular functions.
- **User suggestions**:
  a. Add more languages (e.g., Japanese, Korean, French);
  b. Improve speech recognition accuracy;
  c. Enrich cultural details in interpretation content.

3.2.4 Insights from the Case

1. **Adapt to scenario characteristics in technology architecture**: Select a suitable system architecture based on the scenic area's features (e.g., terrain, tourist volume) to ensure stable operation.
2. **User-centric function design**: Focus on core user needs (e.g., navigation, interpretation) and ensure full bilingual support for key functions.
3. **Continuous experience optimization**: Update the system based on user feedback and integrate emerging technologies (e.g., AI speech, AR).
4. **Integrate technology and human services**: Combine intelligent systems with human services to meet complex needs (e.g., in-depth cultural interpretation).

3.3 Comparative Analysis of Museum and Scenic Area Bilingual Interpretation

3.3.1 Difference Analysis

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Comparison Dimension	Museum Scenario (Nanyue King Museum)	Scenic Area Scenario (Scenic Area M)
Service Objective	Cultural communication; enhance international influence	Tourist experience; improve service efficiency
Content Design Focus	Depth/accuracy of cultural information; cross-cultural comparison	Practicality/convenience of information; clear navigation
Technology Application Focus	Intelligent technology as a supplement to human interpretation	Intelligent technology as core support for automation
User Needs	In-depth cultural information demands (mainly international tourists)	Real-time navigation/query demands (domestic + international tourists)

3.3.2 Common Experiences

1. **Take linguistic accuracy as the foundation**: Ensure translation correctness to avoid misunderstandings.
2. **Take cultural adaptation as the key**: Add explanations of cultural differences to improve communication effectiveness.
3. **Take technology support as the trend**: Use intelligent technology to break the limitations of time and space.
4. **Take user orientation as the principle**: Optimize services based on user preferences and needs.

IV. CHALLENGES AND SOLUTIONS OF BILINGUAL INTERPRETATION

4.1 Challenges

4.1.1 Language and Cultural Challenges

1. **Inaccuracy and lack of professionalism**: Frequent translation errors (e.g., incorrect translation of "汉代玉衣 (Hàn Dynasty Jade Shroud)" as "Han Dynasty jade clothes") and inconsistent professional terminology (e.g., "青铜器 (bronze artifacts)" translated as both "bronze ware" and "bronze artifact").
2. **Insufficient cultural adaptation**: Missing cultural background information (e.g., no explanation of the symbolic meaning of "dragon") and inconsistent expression styles of cultural content (alternating between implicit and direct).

4.1.2 Technological and Talent Challenges

1. **Technological limitations**: Limited language coverage, underutilized functions (e.g., only single-mode voice broadcasting), poor compatibility with other tools (e.g., inability to support foreign-language documents), and high costs.
2. **Talent shortage**: Weak foreign language proficiency of staff and insufficient supply of interpreters proficient in minority languages.
3. **Service inefficiencies**: Complicated tax refund procedures and mismatched timelines between pre-authorization and fund unfreezing.

4.2 Solutions

4.2.1 Technology Empowerment

1. **Application of AI large models**: Use domestic large language models to provide multi-language real-time Q&A and emotional narration.
2. **Tiered interpretation**: Customize content for different audiences (e.g., the British Museum classifies explanations by CEFR levels).
3. **Low-cost solutions**: Adopt offline intelligent translation devices (e.g., those used in Zhangjiajie) and QR code-based interpretation. For example, Ruike Translation reduced costs by 30% through QR code technology.

4.2.2 Cultural Adaptation and Standardization

1. **Terminology standardization**: Formulate *Standards for Foreign Language Translation in Public Services* to unify translations.
2. **Cultural analogy**: Use familiar cultural references to explain unfamiliar concepts (e.g., compare "Zhuge Liang's wisdom" to "Greek Odysseus" when communicating with Western tourists).
3. **Native-language review**: Invite native speakers of the target language to polish content (e.g., labeling taboos on French menus).

4.2.3 Talent Development and Ecosystem Optimization

1. **Talent echelon construction**: Train staff in scenario-specific foreign language application and

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launch "young interpreter programs" (e.g., the Wuhou Shrine's program covering 8 languages).

2. **Industry standard promotion**: Promote the adoption of ISO 21707 *International Standard for Bilingual Heritage Interpretation* and build scenic area-specific language corpora.
3. **Ecosystem integration**: Connect to international booking platforms (e.g., Agoda, Klook) and deploy intelligent tax refund terminals supporting direct RMB refunds.

V. CONCLUSION

High-quality bilingual interpretation is a critical tool for cross-cultural communication in the era of globalization. Its development relies on technological innovation, cultural adaptation, talent support, and standardization. By addressing current problems (e.g., uneven translation quality, technological limitations, talent shortages) with targeted solutions, bilingual interpretation can better enhance China's cultural soft power, promote fair cultural communication, and drive the high-quality development of the cultural and tourism industry.

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